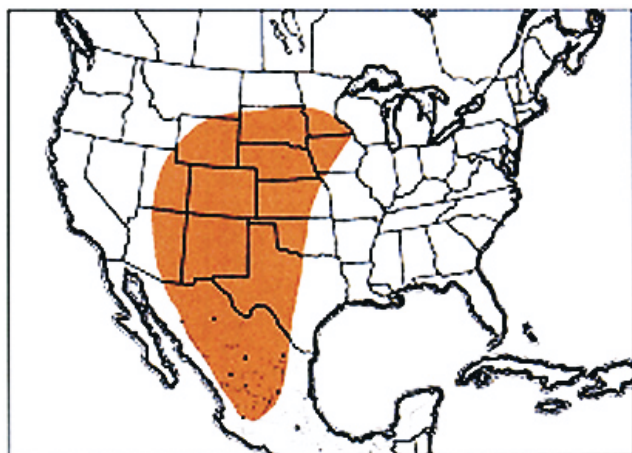


# Lakin Grasshopper

## *Melanoplus lakinus* (Scudder)

### Distribution and Habitat

The Lakin grasshopper ranges widely in western North America inhabiting several types of grasslands and desert shrub regions. Its occupancy of a site depends on the presence of a good supply of food plants, especially several members of the goosefoot family (Chenopodiaceae). Native host plants include species of *Atriplex* and probably species of other genera. In recent times this grasshopper has been aided in its population growth by the invasion of exotic weeds, principally kochia and Russianthistle. Roadsides and fence rows, as well as weedy rangeland, often harbor large numbers of the Lakin grasshopper.



Geographic range of *Melanoplus lakinus* (Scudder)

### Economic Importance

The Lakin grasshopper does not cause much damage to rangeland forage and in certain circumstances may be a beneficial species. Although it has a wide geographic range on western grasslands, its distribution is largely limited to disturbed areas vegetated by preferred host plants of kochia, Russianthistle, and other weeds. It is absent or rare in prairies in good condition, but it thrives in weedy rangeland. A seven-year study (1966-72) on three land types in the Texas Panhandle—shortgrass prairie, revegetated land, and cultivated land—revealed that Lakin grasshoppers were only present in the weedy revegetated land. In 1959, Arizona populations of the migratory and Lakin grasshopper infested weedy rangeland and together averaged 20 to 50 adults per square yard.

During outbreaks the Lakin grasshopper occasionally becomes a pest of alfalfa, wheat, vegetables, and ornamental flowers. Dense populations inhabiting field margins, fence rows, and roadsides may move into crop land and cause severe damage. When border weeds dried up in 1966, an assemblage of the two-striped, redlegged, and Lakin grasshoppers invaded alfalfa fields in Colorado inflicting considerable damage. Weedy city lots provide favorable breeding areas from which the grasshoppers may move into vegetable and flower gardens.

The Lakin grasshopper is a medium-sized species. Collected from a patch of kochia and Russianthistle on 1 August 1996, 8

miles east of La Junta, Colorado, short-winged males averaged 222 mg live weight and females 331 mg (dry wt 62 mg and 97 mg, respectively).

### Food Habits

The Lakin grasshopper feeds preferentially on plants in the goosefoot family, Chenopodiaceae. Native host plants include species of *Atriplex* (saltbush) and probably species of other genera in this family. The native plants are prevalent in both grassland and desert shrub habitats and appear to support small populations. The invasion of kochia and Russianthistle in the late 1800s into the West provided the Lakin grasshopper with an abundant and steady supply of nutritious host plants. Observations in a tourist rest area 8 miles east of La Junta, Colorado revealed that the nymphs inhabited patches of kochia in early July 1996 and were feeding almost entirely on the leaves of this plant. At this time, Russianthistle plants were just beginning to grow while kochia plants were 8 to 14 inches tall. A month later nearly all the Lakin grasshoppers were adults and Russianthistle had grown tall enough (10 to 33 inches) to equal kochia in height. From their roosting positions high on these two plants the grasshoppers fed on the young leaves and flower buds.

Examination of crop contents of Lakin grasshoppers collected from a weedy pasture near North Platte, Nebraska showed 94 percent of fragments to be kochia and 1 percent each of lambsquarters, western wheatgrass, and downy brome. In a study of grasshoppers inhabiting desert prairie near Alpine, Texas, crop examinations revealed that Lakin adults were feeding on several species of grasses and forbs, utilizing approximately 40 percent grasses and 60 percent forbs.

Confined in laboratory cages, Lakin grasshoppers fed well on dandelion and young wheat plants. On these host plants, the nymphs survived and developed through the nymphal stage, and the adults matured and reproduced. Surprisingly, in two-choice preference tests, Lakin adults selected greater amounts of dandelion than kochia as their food.

### Dispersal and Migration

Populations of the Lakin grasshopper consist mainly of short-winged individuals, a morphological characteristic that limits the species' capability to disperse and migrate. Long-winged forms, however, are not uncommon in populations and as many as 47 percent long-winged individuals have been observed in Arizona in at least one population. The large increase in wing length of macropterous individuals occurs during development of the last or fifth instar, but no external difference in length of the wing pads nor other structural differences exist to identify which nymphs are to become long-winged adults and which short-winged. Mating of long-winged forms among themselves in the laboratory has increased their frequency from less than 4 percent to 39 percent in the F<sub>1</sub> generation.

Studies of movement by short-winged species of grasshoppers indicate that distances traveled vary significantly. For example, short-winged adults of *Phoetaliotes nebrascensis* exhibit daily displacements of 3 to 13 feet and may travel

Instar 1



1. BL 3.9-4.2 mm FL 2.1-2.5 mm AS 12-13.

Instar 2



2. BL 4.9-6.2 mm FL 2.9-3.2 mm AS 15-16.

Instar 3



3. BL 6.9-10 mm FL 4.2-5.9 mm AS 17-20.

Instar 4



4. BL 10-14 mm FL 5.8-7.5 mm AS 19-21.

Instar 5



5. BL 12.5-14.7 mm FL 7.5-9.4 mm AS 21-23.

Figures 1-5. Appearance of the five nymphal instars of *Melanoplus lakinus* - their sizes, structures, and color patterns. Notice progressive development of the wing pads. BL = body length, FL = hind femur length, AS = antennal segments number.

distances of 90 feet or more to reach a better food supply. But a species such as *Hypochlora alba*, which is mainly short-winged and a faithful occupant of its host plant, *Artemisia ludoviciana*, exhibits a shorter daily displacement of 0 to 10 feet. A few individuals, both nymphs and adults, remain on the same plant for an entire day. One fifth instar was observed to remain on its host plant for five consecutive days. Regrettably, a review of the latter significant research by Smith and Grodowitz (1987) was omitted in the fact sheet of *H. alba* (Pfadt 1996). No similar research of movement of the Lakin grasshopper has been done. Its present distribution, however, provides circumstantial evidence that the species has strong powers of dispersal. The common presence of this species in patches of kochia and Russianthistle growing in roadsides, fence rows, city lots, and other isolated areas suggests dispersal into these sites. Probably long-winged individuals colonize new habitats and start an infestation. In subsequent generations, perhaps because of reproductive advantage, short-winged individuals come to outnumber long-winged individuals.

### Identification

The Lakin grasshopper is a medium-sized species, brown with fuscous and yellow markings, and typically with short wings (Fig. 6 and 7). Occasionally a small percentage of a population develops long wings that may extend 1 to 3 mm beyond the apex of the hind femur. The cercus of the male is distinctive (Fig. 9); the base is bulbous and at its posterior edge, carinate, the apical end is finger-like. Arms of the furcula are short, broad basally, and finger-like apically. The medial area of the hind femur is tan with three dark dorsal markings; the lower marginal area of the hind femur is orange, the upper marginal areas are tan with three dark markings. The hind tibia is blue. The venter is frequently yellow or pale tan.

The nymphs are identifiable by their color patterns, shape, and external structures (Fig. 1-5). The head and lobes of the pronotum are noticeably and distinctively striped yellow or tan. In instars I and II the stripes are conspicuous and extend onto the sides of the thorax. In older instars the stripes begin to fade; some may continue to sport stripes while others may lack them except for the crescent.

1. Head in instar I shiny black, yellow or tan line below eye (part of crescent); yellow markings on face; compound eyes with two or three diagonal yellow lines. In instars II to V, head brown or green; crescent yellow or tan, eyes brown with two to three diagonal tan or yellow lines.
2. Pronotal lobes of instars I and II with three curved yellow or tan stripes. Instars III to V may retain the three stripes, but some individuals may have only the crescent stripe.
3. Instar I with medial area of hind femur crossed completely (from top to bottom) by three dark bars.

Figures 6-10. Appearance of adult male and female of *Melanoplus lakinus*, detached wings of male, male cercus, egg pod, and three loose eggs.

In instars II to V three dark bars located in dorsal half of medial area. Tibia pale gray, tan, green, or blue.

4. Body color is black or fuscous in instar I and brown or green in instars II to V.

### Hatching

A late-developing species, the Lakin grasshopper begins to hatch three to four weeks after *Melanoplus sanguinipes* and *Ageneotettix deorum*. In 1992 the Lakin grasshopper started to hatch in southeastern Colorado (tourist rest area 8 miles east of La Junta, elevation 4,100 feet) on 1 June while at Cheyenne, Wyoming (elevation 6,100 feet) on 9 June. In 1993 the species began to hatch 10 days earlier than in 1992. At the La Junta site hatching began on 21 May 1993 and in southwestern Kansas (elevation 2,000 feet) on 19 May. Surprisingly, hatching in Chino Valley, Arizona (elevation 4,600 feet) begins usually about July 3, a month later than in any of the northern sites. The difference appears to be due to the timing of seasonal rainfall. In the mixedgrass prairie of Colorado, Kansas, and Wyoming rains are prevalent in spring while in Arizona substantial rains do not fall until the monsoons arrive in summer. Apparently the Lakin grasshopper has adjusted its life cycle in Arizona to fit the regimen of soil moisture. The eggs retain the characteristic of hatching late and remain viable in the dry soil until moisture conditions become favorable, requiring at least 1 inch of rainfall.

No study has been made of egg development in nature. Laboratory research in Arizona has shown that a diapause occurs and that exposure to a cold period is necessary before the eggs complete embryonic development. In nature the hatching period in northern sites appears to extend over approximately five weeks.

### Nymphal Development

Because of the extended hatching period in habitats of kochia and Russianthistle patches, all instars of the Lakin grasshopper may be present by early summer. The nymphs inhabit their host plants day and night, adjusting their positions vertically to suit environmental conditions (mainly temperature). Both male and female nymphs develop through five instars to reach the adult stage. In a laboratory study at the University of Arizona, nymphs subjected to favorable temperature varying between 95° and 104°F completed the nymphal stage in 28 days. Duration of the instars was I, 5 days; II, 4.5 days; III, 4.5 days; IV, 5.5 days; V, 8.5 days.

### Adults and Reproduction

In southwest Kansas and southeast Colorado the adults begin to appear in early July, but in Chino Valley, Arizona not until mid August. Although maturation of the adults has not been directly studied, several events in the life cycle have been observed. In 1996 at the rest area east of La Junta, Colorado on 5 July, in addition to 79 nymphs, two male and one female adults were captured in sweeping. A mating pair was observed roosting on the host plant, kochia, in this site 30 July, providing evidence of maturation in 25 days or less. No oviposition was observed by 1 August. In southeast Colorado the adults survive for at least two



Male

6. BL 17.5-19.5 mm FL 9.8-11 mm AS 23-26.



Female

7. BL 18.5-22 mm FL 10-12.4 mm AS 23-25.



Wings

8. Detached wings of male.



Cercus

9. End of male abdomen showing cercus, furcula, and subgenital plate.



Egg pod

10. Egg pod and three exposed eggs.



months, August and September. Collection of adults were made from 16 to 19 September 1991 in Kit Carson, Lamar, and La Junta, Colorado. The adults, like the nymphs, spend their whole life on their host plants; only the females appear to come down to the ground in order to oviposit. In a grassland area 30 miles southeast of Tucson, Arizona, a collection of egg pods was made from the crown and upper roots of a bluestem grass, *Andropogon* sp.

The egg pods, deposited by females from La Junta, Colorado into bare soil in the laboratory, were 5/8 to 7/8 inch long, slightly curved, and contained 18 to 22 cream-colored eggs, 3.9 to 4.2 mm long (Fig. 10). In Arizona females oviposit among grass roots and the base of stems. Length of pods is short, 3/8 inch long, and pods contained from 20 to 25 eggs.

### Population Ecology

Populations of the Lakin grasshopper often increase to high densities. From 1956 to 1978 the Cooperative Economic Insect Report recorded large numbers of this grasshopper in 11 years out of 13 in the western region, encompassing the states of Colorado, Kansas, Nebraska, Oklahoma, Arizona, and New Mexico. The majority of these records describe the densities of assemblages of grasshopper species. One record, however, made by USDA entomologists in a research project distinguished the densities of individual species. In 1956, an infestation of grasshoppers on rangeland in southern Arizona (San Rafael Valley, south of Tucson) was dominated by the Lakin grasshopper, which numbered 19 young adults per square yard. The entire assemblage of grass- and forb-feeding species numbered 46 per square yard. A report made in 1973 in Grant County, New Mexico, describes an infestation of only the Lakin grasshopper that numbered 12 to 15 adults per square yard.

In the Texas panhandle, the Lakin grasshopper in 1972 outnumbered other species in a study of weedy rangeland and was present in smaller numbers in 1967 and 1970. No specimens were collected in 1966, 1968, 1969, and 1971. Probably the species was present these years, but in numbers too low to be collected by routine sweeping with an insect net. These data indicate that the density of populations of the Lakin grasshopper fluctuate, but give no hint as to causes.

Patches of kochia and Russianthistle foster and support dense populations of the Lakin grasshopper. In the La Junta site on 4 July 1996, nymphs (III to V instars) numbered 91 per square yard. Four weeks later the density of the population, which consisted now mainly of young adults, decreased to 16 per square

yard. Observation showed that the number and volume of kochia and Russianthistle patches had increased. The circumstantial evidence indicated dispersal as well as normal mortality of the population.

### Daily Activity

Lakin grasshoppers inhabiting patches of kochia and Russianthistle conduct nearly all activities on the host plants, behaving as phytophilous insects. For 24 hours of the day they feed, grow, molt, mate, bask, and roost on the host plants.

In the disturbed site near La Junta, Colorado in July and early August, 1996, Lakin grasshoppers moved vertically on plants in response to environmental conditions. During the night nymphs sat vertically 1 inch below the plant tips, head-up on stems and leaves of kochia. In early July, kochia plants ranged from 8 to 14 inches in height, while Russianthistle plants were just starting to grow. Temperatures during the first week of July were unusually high, reaching 105°F during the early afternoon and decreasing to 70°F by early morning. A month later the majority of nymphs had become adults and both kochia and Russianthistle had grown to 12 to 24 inches in height. During the night the adults rested vertically, head-up on the main and secondary stems 1 to 13 inches below the tips. Temperatures were cooler in early August than in early July with early morning temperatures dipping to 65°F.

One to two hours after sunrise, nymphs and adults climbed and adjusted positions to begin basking in the sun. Oriented vertically and head-up, the majority turned a side perpendicular to the rays of the sun and lowered the associated hindleg. After basking for one to two hours, the grasshoppers backed down 4 to 6 inches. A few crawled with head pointed down, but as soon as they reached the desired lower level, they turned around and faced upward. Many roosted quietly, some stirred and changed position on the host plant, and a few jumped 5 to 6 inches to another host plant.

Feeding began early in the morning from 7 to 8 a.m. when air temperatures ranged from 70° to 75°F. The nymphs fed on the edge of young kochia leaves while adults fed on terminal tissues and leaves of kochia and Russianthistle.

When air temperatures in the afternoon became unusually high, 105°F in early July, the grasshoppers took evasive action. The nymphs rotated on the stems to be in the shade. Further research of the behavior of Lakin grasshoppers is needed to disclose their activities on rangeland.

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